

CLAIMS

What is claimed is:

- 1 1. A method of generating a distance map comprising the steps of:
- 2 a) identifying a boundary curve of a source image; and
- 3 b) assigning a distance value to each pixel of the distance map
- 4 associated with a corresponding region of the source image, wherein for
- 5 each pixel, the distance value represents a distance between a center of that
- 6 pixel and a nearest point of the boundary curve, wherein the nearest point
- 7 is located to sub-pixel accuracy.
- 1 2. The method of claim 1 wherein step a) further comprises the steps
- 2 of:
- 3 i) generating an unsigned graylevel image corresponding to the
- 4 source image; and
- 5 ii) applying a threshold value to the unsigned graylevel image
- 6 to form a signed graylevel image, wherein a sign change between graylevel
- 7 values of adjacent pixels indicates a boundary curve intersection, wherein
- 8 the sign change identifies the adjacent pixels as boundary pixels.
- 1 3. The method of claim 2 wherein step b) further comprises the step of:
- 2 i) calculating a distance from a center of each boundary pixel to
- 3 a nearest interpolated boundary curve intersection as the distance value
- 4 for boundary pixels; and
- 5 ii) propagating distance values from each pixel to adjacent pixels
- 6 to generate an unsigned interim distance map.

1 4. The method of claim 3 wherein for each selected pixel, m_i = the
2 minimum of the distance values of the neighboring pixels above and
3 below the selected pixel, wherein m_j = the minimum of the distance
4 values of the neighboring pixels to the left and right of the selected pixel,
5 wherein h corresponds to a pixel size, wherein T_{ij} = a current distance
6 value for the selected pixel, wherein a proposed update value, u , is
7 assigned a value as follows:

8
$$u = \frac{m_i + m_j + \sqrt{2h^2 - (m_i - m_j)^2}}{2}, \text{ if } |m_i - m_j| < h \text{ otherwise } u = \min(m_i, m_j) + h,$$

9 wherein T_{ij} is updated to $\min(T_{ij}, u)$.

1 5. The method of claim 3 wherein step b) includes the step of
2 performing each of the following passes to propagate the distance
3 information throughout the image: top-to-bottom and left-to-right, top-to-
4 bottom and right-to-left, bottom-to-top and left-to-right, bottom-to-top and
5 right-to-left.

1 6. The method of claim 3 wherein step b)(ii) further comprises the step
2 of assigning a sign of each pixel of the signed graylevel image to the
3 distance value in the corresponding location of the unsigned interim
4 distance map to generate a signed first distance map.

1 7. The method of claim 6 further comprising the step of:

2 c) downsampling the first distance map to generate a second
3 distance map having a second resolution.

- 1 8. The method of claim 7 further comprising the step of:
2 d) applying a soft threshold filter to the second distance map to
3 reconstruct the source image, wherein the reconstructed source image has
4 the second resolution.
- 1 9. The method of claim 7 further comprising the step of:
2 d) applying an interpolation filter to the second distance map to
3 generate an interpolated distance map having the first resolution.
- 1 10. The method of claim 9 further comprising the step of:
2 e) applying a soft threshold filter to the interpolated distance
3 map to generate a reconstructed source image having the first resolution.
- 1 11. The method of claim 1 wherein the source image comprises
2 boundary curves defined by continuous parametric functions.
- 1 12. A method comprising the steps of:
2 a) computing a first distance map of a source image; and
3 b) downsampling the first distance map having a first
4 resolution to form a second distance map having a second resolution.
- 1 13. The method of claim 12 further comprising the step of:
2 c) applying a soft threshold filter to the second distance map to
3 form a reconstructed source image having the second resolution.

1 14. The method of claim 12 further comprising the steps of:
2 c) interpolating the second distance map to generate an
3 interpolated distance map having the first resolution; and
4 d) applying a soft threshold filter to the interpolated distance
5 map to generate a reconstructed source image having the first resolution.

1 15. The method of claim 12 wherein the first resolution is greater than
2 the second resolution.

1 16. The method of claim 12 wherein step a) further comprises the steps
2 of:
3 i) identifying at least one boundary curve of the source image;
4 and
5 ii) assigning a distance value to each pixel of the first distance
6 map, wherein each pixel is associated with a region of the source image,
7 wherein for each pixel, the distance value represents a distance between a
8 center of that pixel and a nearest point of a nearest boundary curve,
9 wherein the nearest point is located to sub-pixel accuracy.

1 17. The method of claim 16 wherein step (a)(i) further comprises the
2 step of applying a threshold value to a graylevel rendering of the source
3 image to form a signed graylevel image, wherein a sign change between
4 graylevel values of adjacent pixels indicates a boundary curve lies between
5 centers of the adjacent pixels, wherein the sign change identifies the
6 adjacent pixels as boundary pixels.

1 18. The method of claim 16 wherein step (b)(ii) further comprises the
2 steps of:
3 1) calculating a distance from a center of each boundary pixel to
4 a nearest interpolated boundary curve intersection as the distance value
5 for boundary pixels; and
6 2) propagating distance values from each pixel to adjacent pixels
7 to generate an unsigned distance map.

1 19. The method of claim 18 wherein step b)(ii) further comprises the
2 step of assigning a sign of each pixel of the signed graylevel image to the
3 distance value in the corresponding location of the unsigned distance map
4 to form the first distance map.

1 20. The method of claim 14 wherein the threshold filter is a soft
2 threshold filter such that distance values less than a first pre-determined
3 threshold ($z1$) are mapped to a first value, wherein distance values greater
4 than a second pre-determined threshold ($z2$) are mapped to a second
5 value, wherein $z1 < z2$, wherein distance values between $z1$ and $z2$ are
6 mapped to unsigned graylevel values $[0, N]$.